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UNITED STATES DEPARTMENT OF ENERGY

SUMMARY OF PUBLIC SCOPING COMMENTS CONCERNING PROPOSED REMEDIATION OF PAD A AT THE RADIOACTIVE WASTE MANAGEMENT COMPLEX OF THE IDAHO NATIONAL ENGINEERING LABORATORY (INEL)

From meetings held in

Boise December 9, 1991

- Moscow December 10, 1991

Twin Falls December 11, 1991

Idaho Falls December 12, 1991

PREPARED BY ASI

Contract No. DE-AC07-90ID12918

SUMMARY OF SCOPING COMMENTS ON PAD A

The U.S Department of Energy Idaho Field Office (DOE-ID) held a public comment period on the scope of the Pad A (Operable Unit 7-12) Remedial Investigation/Feasibility Study (RI/FS). This scoping comment period ran from December 4, 1991 to January 17, 1992. In addition, DOE-ID conducted a series of public scoping meetings in four Idaho communities. These meetings where held in Boise, Moscow, Twin Falls and Idaho Falls on December 9, 10, 11, and 12 of 1991. At this series of meetings, two other topics were also included on the meeting agenda. These topics were scoping on the Vadose Zone Organics RI/FS (Operable Unit 7-08) and a technical briefing on the Pit 9 Interim Action Proposed Plan (Operable Unit 7-10). All three projects are part of the Radioactive Waste Management Complex (RWMC) which is also referred to as Waste Area Group 7 (WAG 7).

The objective of scoping for Pad A at these meetings was threefold. The first objective was to provide the public with information concerning the status of the Pad A investigation and to answer questions regarding the technical details associated with Pad A. The second objective was to identify and receive comments on potential alternatives for addressing contamination at Pad A. The third objective was to identify potential environmental impacts that could result from cleanup alternatives. Public scoping comments on Pad A will be used by DOE-ID to help determine how to proceed with impact analysis to meet the requirements of the National Environmental Policy Act (NEPA).

Greg Hula, DOE-ID Project Manager for Pad A, provided an informational presentation at each meeting concerning the Pad A investigation. Mr. Hula provided information about the history of Pad A, including a description of the pad, disposal practices at the pad, the condition of barrels and boxes (as identified during earlier retrieval

tests), current environmental issues and concerns, potential issues that sed further investigation, regulatory guidelines and criteria, and schedules and timelines for the project.

A total of approximately 200 people attended the four meetings. Many of the participants provided oral comments during these meetings. A summary of comments recorded on flip charts during the meetings is provided as Attachment A. Three written comments relating to Pad A were also submitted during the comment period (Attachment B). Comments received on Pad A fell into several key topical areas.

- Drums and boxes
- The physical condition of Pad A
- Pad A wastes and potential contamination
- Risks and the risk assessment.
- Pad A "cleanup" and prioritization
- Alternatives

The following is a summary of written and oral comments made in each of these topical areas:

DRUMS AND BOXES

Several commentors sought information on the 1989 Pad A drum retrieval project and asked about the results. Many expressed concern about the condition of drums on Pad A and at the RWMC in general. One commentor asked if the salts contained in Pad A wastes could accelerate the deterioration of the barrels and boxes if the containers had been breached.

THE PHYSICAL CONDITION OF PAD A

Apart from the contents of the pad many participants asked about the integrity of the asphalt pad and wanted to know if its integrity was good enough to prevent waste migration. Several stated that the integrity of the pad should be studied. Other commentors suggested that the pad was probably in good enough shape to allow the wastes to remain in place and undisturbed without significant risk.

PAD A WASTES AND POTENTIAL CONTAMINATION

There were many questions about the nature of the contents of the boxes and drums. Commentors asked if the wastes stored on Pad A were mixed wastes and how much transuranic waste was present. Many asked if these wastes were leaking and causing groundwater contamination. One commentor expressed concern about leaking containers releasing the nitrate salts, reacting with moisture, and causing other containers to corrode faster. Another questioner asked if beryllium was the primary contaminant of concern driving the cleanup of Pad A.

The transuranic content of Pad A wastes was of particular concern to one commentor who stated that transuranic content must be better quantified. The commentor stated that the phrase "relatively small amounts" used in the Pad A fact sheet was vague and did not provide the public with enough information. The commentor also expressed concern about the total mass of plutonium contained in the waste stored on Pad A. Specifically, the commentor wanted to know the number of plutonium particles and the size of those particles. It was suggested that the relative amounts of plutonium should be compared to the amounts present in soils as background. Several participants asked if the 16 drums of transuranic waste stored at Pad A could be found, segregated, and sent to the Waste Isolation Pilot Plant in New Mexico.

RISKS AND THE RISK ASSESSMENT

There were a number of questions regarding the risk assessment and its availability. Additionally, several participants expressed concern that handling the drums would pose added risks of worker exposure as well as risks to the environment such as air and ground water.

THE PAD A PROJECT AND PRIORITIZATION

A number of commentors stated that Pad A is a low-risk action and doesn't warrant being prioritized for cleanup at this time when there are more serious problems (particularly buried waste) that are not being acted on. It was suggested that the prioritization of all of the WAGs should be based on a WAG-wide risk assessment so that the most significant problems are addressed first. One commentor suggested that DOE should stay on schedule and within budget for the Pad A project.

COMMENTS ON ALTERNATIVES

Several commentors suggested that biotechnology should be considered as an alternative for concentrating radionuclides. It was also added that the sodium and potassium nitrate salts could be used as a nutrient source for other bioremediation projects at the RWMC.

Several commentors asked about the potential for off-site disposal alternatives, particularly with regard to transuranic wastes removed from Pad A. Another commentor stated that all materials from Pad A should be recycled after being decontaminated. Other commentors were concerned about the removal and handling of drums and the exposure that might result.

Several commentors suggested leaving Pad A wastes in place and sing a cap or other type of in-place stabilization. One commentor suggested covering the pad with a 4 acre concrete cap. This cap would be centered over Pad A and should have a 6 inch curb to contain runoff. It was suggested that this capping proposal would be protective of the human health and the environment and would eliminate the need for sorting, handling, packaging, transporting, and redisposing of the Pad A wastes and would thereby minimize worker exposure.

ATTACHMENT A

SUMMARY OF SCOPING COMMENTS RECORDED ON FLIP CHARTS

PAD A

Summary of Public Comments, Questions, and Opinions Received at Workshops Conducted in Boise, Moscow Twin Falls, and Idaho Falls

Dec. 9-12

General Comments, Questions

Was a drum retrieved from Pad A for testing?

Why have the drums deteriorated?

Have any drums been breached at Pad A or RWMC?

Are the contents of the boxes causing groundwater contamination?

Is the integrity of the Asphalt Pad being studied?

Is the asphalt pad thick enough to prevent waste migration?

How would potassium and nitrate salts react if in contact with moisture? Will the salts accelerate the deterioration of the barrels and boxes if the integrity of the containers have been breached?

Consider recycling all materials from Pad A after they have been decontaminated.

Pad A Waste Characterization, Issues, and Questions

Are the wastes stored on Pad A mixed wastes?

Can the 16 TRU drums disposed at Pad A be found and separated from the

other drums and boxes?

Does DOE know where the 16 TRU drums are?

What mass of plutonium is contained in the waste stored on Pad A?

How many plutonium particles are present in the 12 grams of plutonium in the wastes disposed on Pad A?

How much plutonium is there from fallout in comparison to the amount in Pad A? (Please provide a comparison using a recent event such as Three Mile Island, Chemobyl, or the detonation of a nuclear device.)

Can Pad A waste go to WIPP?

Risks and the Risk Assessment

the risk assessment available?

How would drums be removed? Is there a risk of damaging the drums and allowing poisonous gases and liquids to escape into the air and ground?

Since the majority of waste is low-level, is Beryllium (Berylliosis) driving the cleanup of Pad A as the primary contaminant of concern?

Prioritization

Pad A is a low-risk action and it doesn't make sense to prioritize its cleanup at this time when there are more serious problems (particularly buried waste) that are not being acted on.

The prioritization of all of the WAGs should be based on a WAG-wide risk assessment so that the most significant problems are addressed first.

Identification and Comment on Alternatives

Research has been conducted concerning bioconcentration of Radionuclides. Bioremediation should be investigated as an alternative.

The sodium and potassium nitrate salts should be considered as a medium to assist the bioremediation of other sites at SDA.

Off-Site disposal alternatives were considered for Pit 9, why not Pad A?

ATTACHMENT B

WRITTEN COMMENTS SUBMITTED

Record of Written Comments Received During the Public Comment Period on Scoping for Pad A

December 13 to January 17, 1992

NAME A	DDRESS	DATE	<u>PAGES</u>
Informational Meeting Comments		DECEMBER '91	
	6024 Latigo Dr., Boise, ID 83709 1718 N. 14th Street, Boise, ID 83702	-09	1
Written Comments During Comment Period			
Jostin Talcott Peter Rickards	1105 Orlin, Idaho Falls, ID 83404 Box 1411, Twin Falls, ID 83301	-30 -31	1 12
		JANUAR'	Y '92

Pad A Scoping

Written Comment Sheet

RECEIVED

The comment period on the study of wastes disposed above ground on Pad A will run until toreston January 17, 1992. You may wish to use this form to submit written comments tonight, or mail it later to: Walter N. Sato, Environmental Restoration Division, DOE Idaho Field Office, 785 DOE Place-MS 3902, Idaho Falls, ID 83401-1562. Comment(s): I believe that Pad A should have a 4 acre concrete pad placed over it so that Pad A is located in the very center. There could be a 6" curb all around the edge of this pad to prevent rainwater and snow melt from draining off the pad edge. This could prevent any water from draining through the soil to disperse the contamination underneath into the aquifer. This would also prevent possible spread af contamination to the surface of the land there. The pad should be built of high quality materials to prevent penetration by water and to maintain it's integrably for centuries. It could be used as a parking lot or a skating rink or any other useful purpose as well. I believe the soil under this pad would then be undisturbed for centuries and would serve as the best available long term storage package for the materials. This would be far less expensive than all the other methods of disposal mentioned. If some sort of sorting took place you would still have to find a place to store the waste and that would still entail certain envioronmental hazards in addition to the exposure of the personnel doing the sorting, handling, packaging, transporting and burying processes. Name: Jostin Talcott

Mailing Address: 1105 Orlin Idaho Falls Id. 83404

Pad A Scoping

Written Comment Sheet

ie comment period on the study of wastes disposed above ground on Pad A will run until January 17, 1992. You may wish to use this form to submit written comments tonight, or mail it later to: Walter N. Sato, Environmental Restoration Division, DOE Idaho Field Office, 785 DOE Place-MS 3902, Idaho Falls, ID 83401-1562. Comment(s): y the agenta of disruption not marganela Thank you - very much Name: Olin & Mari, M. Hikkola Boise, Idaho 83709 Mailing Address: 6024 Hatis Dr. D'arathy Howard
1718 N. 1484. St.
Beise, Idaho 83762

PUBLIC COMMENTS FOR DEC. 11, 1991 INEL MEETING ON CLEAN UP OF PIT 9, PAD A, AND THE VADOSE ZONE

It is illegal and dangerous to public health to proceed as planned with the clean up of Pit 9 at INEL. Basic important information needed to evaluate the risks of different plans is unknown, but has been requested at the NEPA scoping hearing for the PEIS waste management and environmental restoration. It is illegal and dangerous to proceed until that Record of Decision in 1993 and that PEIS also has been delayed by lack of funding.

Please see the submitted scoping questions and documents on HEPA filter inefficiency for smaller particles like the dangers Pu-239.

Because the HEPA filters are not 99.97% efficient for smaller particles, all the calculations for human exposure of the preferred Alternative 4 are based on inaccurate data for exhuming loose waste barrels. More Pu 239 will be released than calculated so .ccurate re-evaluation must be done AFTER the basic HEPA filter efficiency is established for the unique particles involved.

This is important because Alternative 2 would solidify the waste in ground, and HEPA filters would be only a back up safety measure, probably unneeded, allowing nearly 100% less airborne radioactivity, the major pathway of concern according to DOE documents.

In fact, page 6 of the plan admits Alternative 2 "provides the best protection to the community and workers during remediation activities." For Plan 6, I suggest Alternative 2 be combined with Alternative 5, for the full 500' of the Vadose zone as well as Pit 9. By solidifying the waste in place, it can also be removed safer, stored safer and then disposed of off-site when a permanent dump site has been chosen for a national sacrifice zone.

While DOE is calling waste storage "safe" in public and going to court to bring in out-of-state waste, it is ironic that on page 7 they complain about Alternative 5 saying, "Storage of the large quantity of packaged waste in Alternative 5 could potentially pose a radiological hazard to the workers, community and environment." Gee, I thought you said it was safe to store waste at INEL!

To add to the absurdity, Alternative 4 is ranked Best for long term effectiveness. But Alternative 4 returns these long-lived radionuclides back into the pit. Page 9 states

this return to the Pit, but this can't be safer for Idaho than off-site disposal. Note the 1980 WIPP manual in Chapter 2, page one, where DOE scientists state, "There is no suitable geology at INEL" for these radionuclides. So why rebury them?

On page 7, Alternative 4 would have a test phase of "approximately 9 months...because this technology has not been widely applied to complex mixed waste sites." But alternatives 2 and 3 are dismissed because their tests would be new to mixed waste. Despite glowing press releases for tests on ISV, no timetable is stated for their completion, yet they are dismissed for lack of implementibility. Wait for the tests to finish since this is the "best protection."

There appears to be a discrepancy on page 9 for the lower cost for excavation for Alternative 4 compared to #5. Why does 5 cost more? The big cost difference is in storage until off-site disposal, but what about the cost to Idaho agriculture if the reburied waste leaks in "INEL's unsuitable geology.?"

Please note 1989 National Academy of Science's statement about the huge up front cash needed for robots for INEL's RWMC. In your plan where are the robots and where's the up front cash?

Page 6, is wrong by stating Alternative 4 reduces toxicity by increasing the concentration of Americium and plutonium. This highly toxic concentration when removed is now available to on-site transport accidents and airborne dispersion. So it can actually increase mobility and toxicity, especially compared to I.S.V., then off-site disposal.

Everything but Alternative 5 plus my plan ruin the opportunity to work on the Vadose zone excavation.

Pad A has no plan, but the quantity of Pu 239 + Americium must be stated, not dismissed as "relatively small amounts." When the National Academy of Sciences states "even a small isolated particle of plutonium emits appreciable radiation" it is in Idaho's long-term and short-term interest to remove them and dispose off the site.

The Vadose Zone must be checked for how much Pu 239 + Americium is present there. Most of all the 800 lbs. of TRU waste may have already leaked there and if you still can't test or quantify it — then ISV and removed it all to above ground monitored retrievable storage until off-site dumps are forced open.

The Vadose Zone scoping facts must also evaluate inhalation vs. oral consumption for chemicals involved before we make it worse for the air by vapor vacuum extraction.

In summary, please get your heads out of your asses and start thinking about —ceping the 1970 promise to Governor Andrus that all waste will be removed from Idaho.

Sincerely,

Dr. Peter Rickards, DPM

Dr Poter Rickards APM

Box 1411

Twin Falls, Idaho 83301

Enclosed () E.B. Moore - Guther Technology...
(2) Pu O2... F.L. Horn
(3) Ence. Sumon WIPP 1980
(4) Nuclear Wangons Complex 1989 - NAS.

PNL--4621-Final
DE85 005817

CONTROL TECHNOLOGY FOR RADIOACTIVE EMISSIONS TO THE ATMOSPHERE AT U.S. DEPARTMENT OF ENERGY FACILITIES

E. B. Moore, Project Manager

October 1984

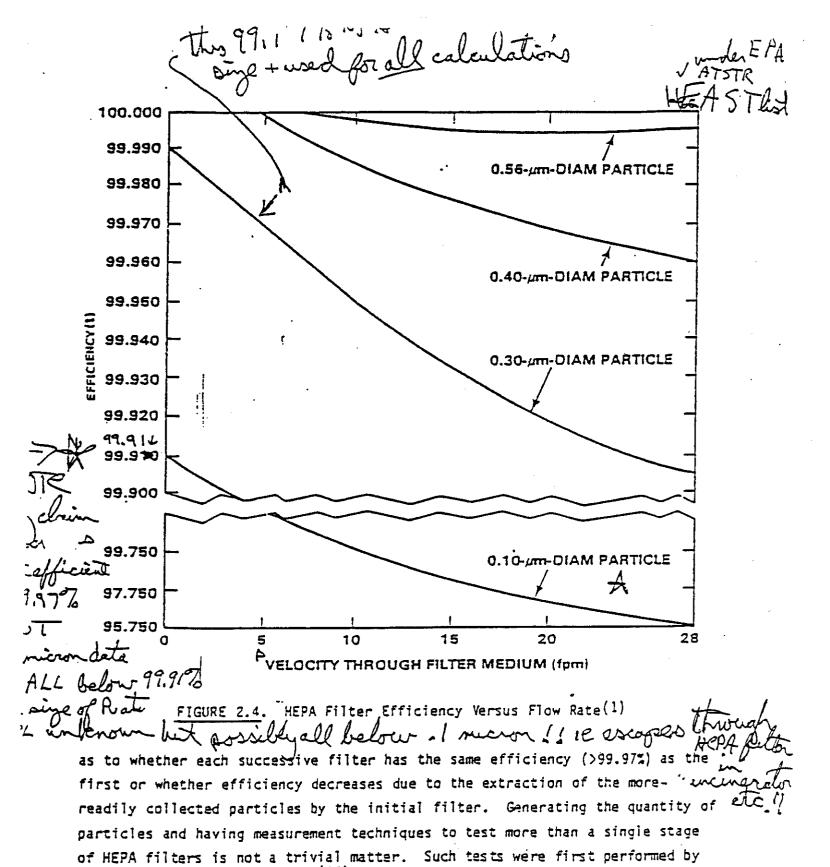
Prepared for the Eastern Environmental Radiation Facility U.S. Environmental Protection Agency Montgomery, Alabama

Under a Related Services Agreement Contract OE-ACO6-76RLO 1830

Pacific Northwest Laboratory Richland, Washington 99352







Gonzales, Elder, and Ettinger (16) using plutonium with an activity median



PuO₂-UO₂-Na AEROSOLS PRODUCED BY VAPORIZATION OF FAST REACTOR CORE MATERIALS *

F.L. HORN AND A.W. CASTLEMAN, Jr. BROOKHAVEN NATIONAL LABORATORY, UPTON, NEW YORK, UNITED STATES OF AMERICA

Abstract

PuO₂-UO₂-NA AEROSOLS PRODUCED BY VAPORIZATION OF FAST REACTOR CORE MATERIALS. A hypothetical accident for fast reaction predicts expulsion of sodium coolant from the core, gross meiting and vaporization of fuel into a containment vessel which may contain air or an intert gas for safety reasons. The vaporized fuel subsequently condenses into an aerosol composed of PuO₂ and UO₂ mixed with Na. The characteristics of these aerosols were middled by vaporizing fuel and sodium into various atmospheres to simulate accident conditions.

In all aumorpheres, the individual PuO₂ and UO₂ particles formed are cubic in shape and range in rice from 40 to 400 Å on an edge. Initially, these particles rapidly consquiate into chain and citater aggregates measuring 0.05 to 0.3 µm in equivalent diameter. In humid sit, the sodium oxide forms spheres and citaters of spheres with an initial count medium emitter (CMD) of 0.17. However, in dry nitrogen the sodium shapes are more irregular and have a 0.30-µm initial CMD. The congulation constant for PuO₂ in dry nitrogen ranges from 3 x 10⁻¹⁹ to 9 x 10⁻¹⁹ cm³/sec during the 24 hours after generation. At a mass concentration of CM mg Pu/m³, a typical initial CMD for PuO₂ is 0.14 µm with a geometric regulard deviation of 2.5. The mass concentration decreases rapidly with time but tends to reach a "trable" value of 10 µg Pu/m³ after mass concentration decreases rapidly with time but tends to reach a "trable" value of 10 µg Pu/m³ after mass concentration.

The combined serosols of PuO₂, UO₂, and Na produce fairly constant size distributions depending upon the atmosphere in which they are formed. These agglomerates are composed of twitting chaims of cubic shaped particles into which are incorporated sodium spheres and clusters. Dry microgen atmospheres produce agglomerates with a CMD of 0.5 to 0.3 µm, while humid air produces much smaller agglomerates having a CMD of 0.25 to 0.39 µm.

A CDC 6800 computer was used to integrate numerically the conquistion relationships formulated by Smoluchowski, with terms added to account for particle formation and serting. Using the experimental data on the particle size distributions and the aerosal number density as a function of time, agglomeration coefficients were evaluated. In addition, the time dependence of the total airborne mass concentration was evaluated by integrating the product of the number density and particle density over all values of the particle radii.

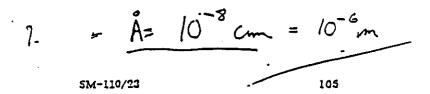
Introduction

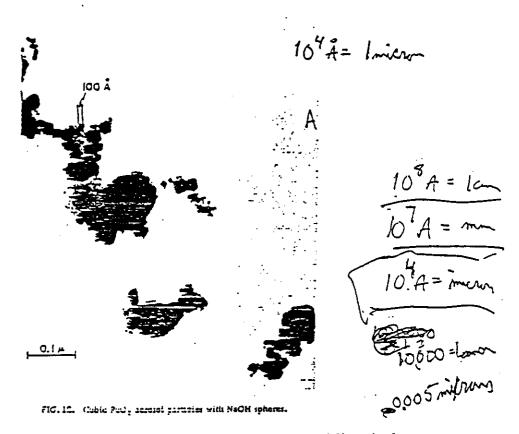
The prospect that the continued development of fast reactors fueled with plutonium will result in an abundance of these reactor types requires careful consideration of their safety aspects. Numerous safeguards engineered into their construction and operation should cope with nearly all foreseable accident conditions of the first and second level.

When consideration is given to the third level of reactor safety, i.e., to the highly unlikely occurrence of a simulta-

neous _arune of all procedure everage at the time of a

^{*} The research was performed under the suppose of the Cliffich





A picture of the PuO2-Na aerisol taken at a magnification of 224,000 clearly shows the cubic structure of the PuO2 crystals as seen in Figure 12. A coating of lighter density sodium or sodium hydroxide along with larger sodium spheres is also visible. The PuO2 cubes range in size from <50 Å to about 0.1 microns, and are generally smaller in size than the UO2 cubes shown in earlier reports. The apprepares of PuO2 are composed

of many of these small cubic particles.

The possibility of ecrosor resuspension as a result of the agitated movement of the settling chamber walls was investigated. The chamber was sampled prior to and after the chamber was collapsed from the sides and bottom following a plutonium aerosol run. No particles were found on the thermal precipitator sample grids before or after the agitation, indicating little or no resuspension due to movement of the chamber sides. Therefore, the persistent nature of the airborne plutonium concentration is evidently associated with the physical characteristics of the aerosol.

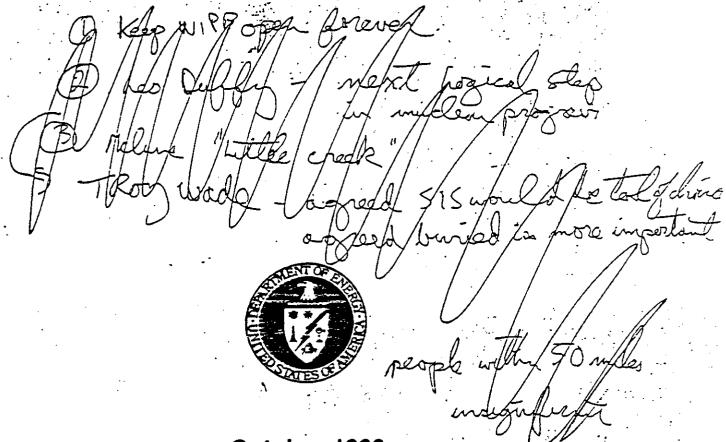
 $\lambda~00_2$ aerosol was generated in the 0.81-m³ chamber containing nitrogen gas with a relative humidity of 70%. The aerosol had an initial mass concentration of 30 mg/m³ and a

A

EXECUTIVE SUMMARY ENVIRONMENTAL IMPACT STATEMENT

(DOE/EIS-0026)

Waste Isolation Pilot Plant



October 1980

U.S. DEPARTMENT OF ENERGY

2.0 ALTERNATIVES AND THEIR ENVIRONMENTAL IMPACTS

This chapter discusses the development of the alternatives evaluated in the WIPP Environmental Impact Statement. The environmental impacts of these alternatives are evaluated and compared.

2.1 ALTERNATIVES FOR THE WIPP MISSION

2.1.1 Alternatives for TRU Waste Disposal

Three alternatives may be considered for the TRU-waste-disposal portion of the WIPP mission. They are: (1) no action; (2) a WIPP in southeastern New Mexico; and (3) delay. Delay could be delay in building at the Los Medanos site, delay for the sake of considering additional possible sites, or delay to eliminate the need for a separate TRU waste repository by allowing this waste to be disposed of in a high-level waste (HLW) repository. Delay could also be for various periods of time.

The "no action" alternative for TRU-waste disposal means retention at the Idaho National Engineering Laboratory (INEL) of the readily retrievable TRU waste expected to be there through 1990. This waste could be held in its present storage or placed in improved storage at the INEL for an indeterminate period of time. The possibility of geologic storage at the INEL has also been considered. However, this approach is technically unsuitable for the following reasons:

- There is no suitable geologic environment at the INEL. The INEL is on the Snake River Plain and is underlain by the very important Snake River aquifer.
- The only part of the INEL not located over the aquifer is not considered a promising site, because of unknown hydrologic characteristics. Existing mines in this area are troubled by groundwater and hydrologic connections with the aquifer are suspected.

Accordingly, the long-term management of this waste requires offsite disposal.

2.1.2 Alternatives for Research-and-Development Studies

Four alternatives might be considered for the research-and-development (R&D) portion of the WIPP mission: (1) no action (i.e., reliance on laboratory studies alone); (2) a facility devoted solely to R&D; (3) an R&D facility in the WIPP; and (4) an R&D facility in the first available high-level waste repository.

In order to advance knowledge about radioactive waste disposal, it is necessary to conduct full-scale experiments with wastes in an actual facility. Continued laboratory experiments are not believed to be a useful research and development alternative.

THE NUCLEAR WEAPONS COMPLEX

Management for Health, Safety, and the Environment

Committee to Provide Interim Oversight of the DOE Nuclear Weapons Complex Commission on Physical Sciences, Mathematics, and Resources National Research Council

National Academy Press Washington, D.C. 1989 behind the use of robots is the escalaring cost of manual operations, another impetus is the effort to cope with conditions that are threatening to humans, such as acute exposure to radiation during emergencies, exposure to contamination in waste-handling operations, and activities in constricted work spaces. In such circumstances, robots can have great advantages over manual alternatives. Robots are also obviously useful for repetitive tasks that demand high precision but that workers may find boring.

The application of robotics or even an awareness of the robotics state of the art varies significantly throughout DOE. Most of the sites have at least fledgling programs in robotics or experience with components that could become the building blocks for more complicated applications. But overall, the weapons complex has generally not taken advantage of more recent advances in robotics. Although the earliest remote manipulators were pioneered for nuclear hot-cell work, subsequent technological evolution was driven more by advances in subsea activities and by missions of the military, the manufacturing community, and most recently, the space program.

Numerous opportunities exist now for applying robotics throughout the complex, but certain targets emerge at specific sites. Of course, successful demonstrations anywhere can always be made more broadly applicable. Examples of opportunities include the following.

- Emergency response. To our knowledge, the complex does not have a viable fast-response force with expertise, devices, personnel, and transportation at the ready in the event of emergencies that limit human response. The responses at Three Mile Island and Chernobyl were hampered by just such a lack of remote equipment, and they focused the world's attention on the need for it.
- Buried tanks (single- and double-walled). Aged, faulty, and contaminated tanks are a generic problem throughout the complex. Robots could play a significant role here in inspection, remedial action, and as necessary, decommissioning. Constricted spaces like the annulus of double-walled tanks also preclude human entry and call for the use of robots.
- Excavation. Buried wastes, such as those in trenches arthe Y-12 Plant, are candidates for unmanned excavation, but the most visible, voluminous, and imminent application is the exhumation of acres of transuranic and mixed wastes at INEL. Robotics is clearly the technology of choice in such applications.

Other opportunities include inspection; characterization and cleanup of ductwork; subsurface mapping, particularly prior to excavation; maintenance of hot cells and repositories without human entry; facility decontamination and decommissioning; and unmanned production processing.

Robotics has the potential to reduce costs and risks significantly, but cost projections must be examined with care: the use of robots involves large up-front investments in engineering and equipment. Opportunities may exist for DOE to

X

Whereis the cash in there BS press release? This is DEC 1989 augustion.



APPENDIX D 121

Because plutonium reacts with the air with the evolution of heat and because it is a poor conductor of heat, it can be pyrophoric, that is, it can spontaneously ignite in air, particularly when in the form of lathe turnings, which have relatively high surface area and poor contact between individual turnings. Such conditions can promote the build-up of a "hot spot" in a small area that can exceed the ignition temperature of the metal. Several serious fires in the weapons complex have started in this manner. To prevent their recurrence, current practice calls for handling potentially ignitable plutonium in enclosures with a low-oxygen atmosphere.

Since plutonium reacts so readily with the air, it is rerely, if ever, found in the metallic form in the environment. Thus the properties of PuO₂, the common environmental form, are most relevant when attempting to assess the behavior of plutonium. Plutonium dioxide can vary in color from tan to olive green to black, depending on purity and conditions of formation; it should be noted, however, that it is not observed in the environment in quantities anywhere near large enough for its color to be perceived by the eye. Typically, when it is present in soils, for example, it is in the form of a relatively small number of microscopic particles. The density of PuO₂ is high compared to that of most chemical compounds, but only slightly more than half that of the metal.

Nevertheless, individual particles, depending on how they were formed, can vary considerably in density and in aerodynamic properties. Particles are frequently very small and can be subject to short-range atmospheric dispersion under suitable climatic conditions. The dispersion will be spatially nonuniform, but even a small isolated particle can emit appreciable radiation. These factors combine to cause high variability in soil contamination analyses: whether a given soil sample contains high radioactivity or no detectable activity whatever may depend on whether it contains a single "hot particle."

Plutonium dioxide is normally quite insoluble in water and in body fluids (with a few exceptions as noted below); it is even less soluble when formed at high temperature, as in a fire. Hence its dispersion in soil is primarily by mechanical means. It can also be blown along the surface by the wind ("saltation"). It can be washed downward into the soil column by natural factors, and it can be spread both horizontally and vertically by plants and animals. Some limited dissolution of PuO₂ can occur in ocean water and in ground-waters with chemical compositions that enhance plutonium solubility, but this does not generally occur in domestic groundwaters because of their low chemical contents.

The low solubility of PuO₂ in body fluids has several ramifications. Uptake through the gastrointestinal system is small, since PuO₂ is poorly absorbed through the intestinal walls. The most serious modes of entry are inhalation and the contamination of wounds. Once in the body, plutonium can be difficult to remove. Inhaled PuO₂ can be lodged in the lungs for considerable periods of time, and ultimately it works its way into the lymph nodes. Plutonium entering the blood stream through a contaminated wound ultimately deposits in the liver or the bone marrow: in the latter site it can be especially harmful to the blood-forming